GEOLOGICAL REPORT ON ANDERSON DAM SITE LOCATED ACROSS COYOTE CREEK IN SANTA CLARA COUNTY, CALIF.

BY

CHESTER MARLIAVE
CONSULTING GEOLOGIST
SEPT. 15, 1949

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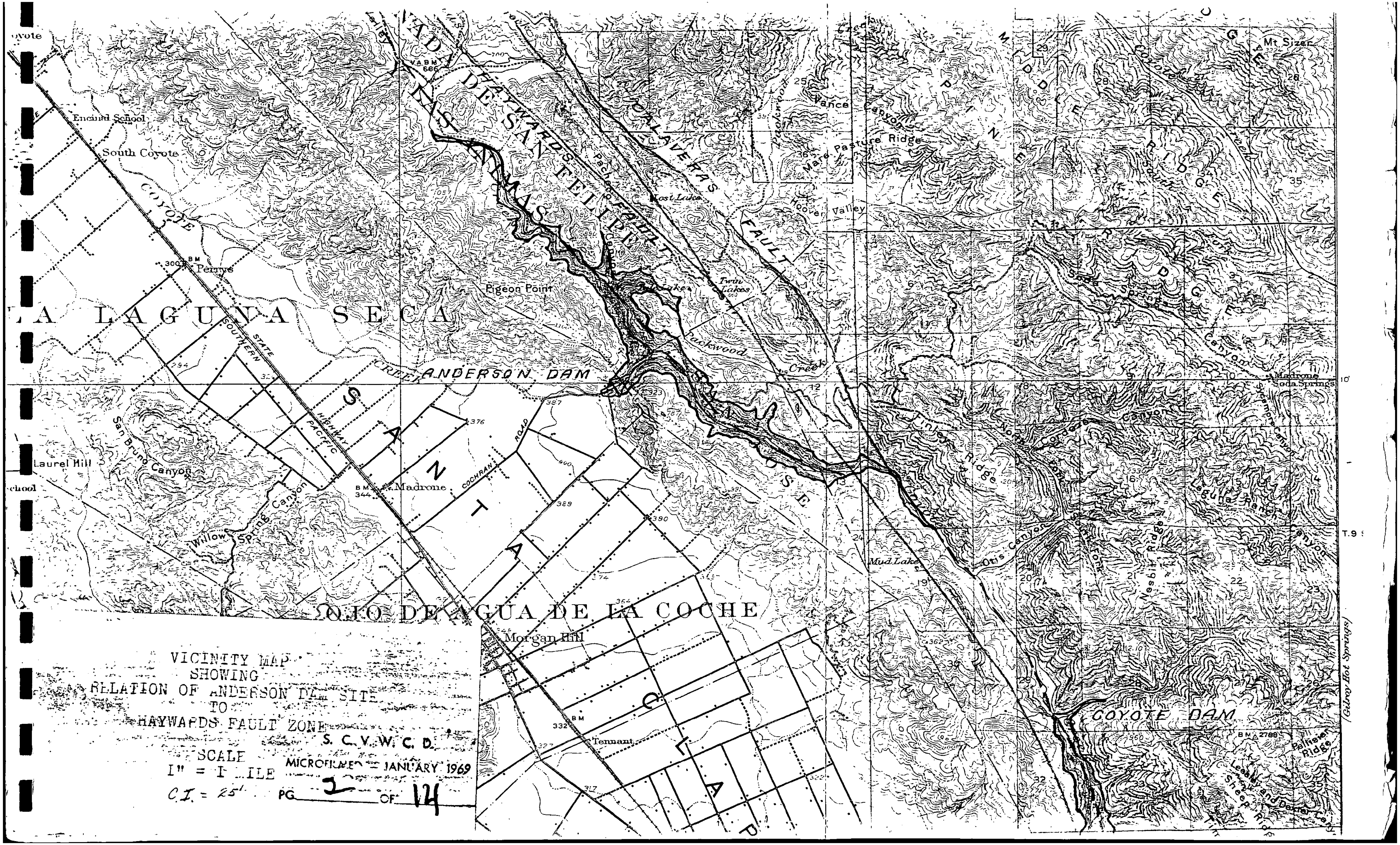

VICINITY MAP
SHOWING
RELATION OF ANDERSON DAM SITE
TO
HAYWARDS FAULT ZONE

SCALE
1" = 1 MILE
C.I. = 25'

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CHESTER MARLIAVE
CONSULTING GEOLOGIST
and
REGISTERED CIVIL ENGINEER
420 Boynton Avenue
Berkeley, California

GEOLOGICAL REPORT ON ANDERSON DAM SITE

LOCATION

The Anderson Dam Site lies across Coyote Creek at the mouth of the canyon where the stream breaks through the hills and debouches upon the eastern slope of the Santa Clara Valley. The site lies in Santa Clara County 2.7 miles north and 1.3 miles east of the town of Morgan Hill and only 6.3 miles downstream from the existing Coyote Dam which lies across the same stream.

The site is reached by turning off of Highway 101 on to the Cochran Road 1/2 mile south of the town of Madrone and then following alongthis paved road in an easterly direction for a distance of 1.7 miles. According to the government subdivisions the Anderson Dam Site would be found in the center of S.10-T.9S.-R.3E.-M.D.B.& M.

PROPOSAL

It is proposed to construct an earth dam at this site that would have a height of about 240 feet above streambed producing a maximum reservoir storage of about 75,000 acre feet. The reservoir thus created would completely control the runoff from the Coyote Creek watershed including the releases past the existing Coyote Dam. The impounded waters in Anderson Reservoir would be discharged into conduits or down the natural stream channel for irrigation and for replenishment of the underground storage in the Santa Clara Valley.

PHYSIOGRAPHY

The watershed tributary to the Anderson Dam Site lies along the western side of the Mt. Hamilton Range and the ground surface elevations range from a maximum of 4209 at the summit of Mt. Hamilton to 400 at the mouth of the canyon where the dam is to be constructed. A small thin capping of snow occasionally covers the higher slopes of the range but for the most part the rainfall runs off the surface immediately during the rainy season.

The canyon in which the Anderson Dam Site is located starts at the junction of Coyote and Las Animas Creeks and runs in a southwesterly direction for a distance of about seven tenths of a mile to a point just downstream from the concrete bridge where Coyote Creek is crossed by the Cochran Road. At this point the canyon emerges upon the floor of the Santa Clara Valley. From here on the stream channel follows along the base of the hills on the right side for about a half mile before it meanders out along the edge of the valley on its way toward South San Francisco Bay. This seven tenths of a mile of canyon has commonly been referred to as the Upper Coyote Gorge.

The outstanding feature of the terrain is the Haywards Fault System which traverses the area in a northwest southeast direction. This system continues southeasterly through the Coyote Dam Site and reservoir as a rather narrow zone approximately 1/3 of a mile wide and finally joins the San Andreas Fault System near the town of Tres Pinos some 60 miles distent. Midway between the Coyote Dam and the Anderson Dam Site the Haywards Fault Zone splits up and continues northwesterly toward the Carquines Straits as a number of widely separated faults. In the area under consideration the four branch faults are considered as being the Calaveras Fault, the Haywards Fault and their two west branches all of which are marked on the Vicinity Map.

The Anderson Reservoir Site occupies the valley that is traversed by the westerly branch of the Haywards Fault. Coyote Creek flows northwesterly through a portion of the Anderson Reservoir Site and is joined by Las Animas Creek which flows southeasterly along the same general trough. Both of these stream courses have been determined by the West Branch of the Haywards Fault. At the confluence of the two streams Coyote Creek makes a right angle turn and runs southwesterly for a distance of about half a mile cutting through a rather high ridge and then emerges upon the floor of the Santa Clara Valley.

RESERVOIR SITE

As can be seen from the attached Vicinity Map the Anderson Reservoir would follow the general trend of the West Branch of the Haywards Fault. The length of the proposed reservoir would about 6 1/2 miles with the two long lineal arms meeting near the middle of it and then continuing at right angles to the trough through the ridge toward the valley. The reservoir trough is comprised of Franciscan sediments and associated igneous rocks but it is partly filled with later deposits of poorly consolidated sediments and remnants of a thin lava flow. The deep seated Franciscan formation also comprises the ridge that seprates the reservoir trough from the Santa Clara Valley so that the basin occupied by the reservoir should be impervious against reservoir seepage. The reservoir is comparatively narrow seldom exceeding 1,000 feet in width but it would be fairly deep. Such canyon type of storage is a favorable feature tending to reduce evaporation loss. The presence of a major fault traversing the length of the reservoir is not conducive to percolation through it because the fault traverses plastic shales and sandstones that give a tight impervious gouge along the fault zone.

REGIONAL GEOLOGY

The Mt. Hamilton Range is made up for the most part of old Jurassic sediments belonging to the Franciscan formation that outcrop over the area for many miles. The Coyote Creek watershed lies entirely within this Franciscan belt. Included between the four branches of the Haywards Fault zone are numerous large bodies of sediments much younger in age than the Franciscan formation. Westerly from Coyote Creek and southerly from the Upper Coyote Gorge the narrow belt of hills that separates the fault zone from the Santa Clara Valley is composed chiefly of igneous Franciscan rocks that are largely altered to serpentine. These serpentine rocks also extend northwesterly across the gorge between the upstream toe of the Anderson Dam Site and the junction of Coyote and Las Animas Creeks, and in general, they comprise most of the the major portion of the hills on the west side of the West Branch of the Haywards Fault.

The slopes of the foothills facing the Santa Clara Valley are flanked in many places by poorly consolidated gravels, sands and clays of Pliocene lakebed origin. Thick beds of similar deposits also occupy an area about 1 1/2 miles wide and extending for 6 miles northwesterly from Coyote Creek between the West Branch of the Calaveras Fault and the West Branch of the Haywards Fault.

Toward the close of the Pliocene depositions a thin volcanic flow of basaltic lava covered most of the area west of the Haywards Fault and remnants of this flow still exist capping the foothills, especially over the area occupied by the serpentine rocks west of the fault zone.

GEOLOGICAL EXPLORATIONS

The geologic investigation of the dam site showed shale and sandstone outcrops along the base of the left abutment where the old county road originally ran, but above the average height of 35 feet above streambed no other bedrock outcrops were in evidence on this abutment. On the right abutment exposures of serpentine, shale and sandstone were in evidence along the base of the hill upstream from the axis of the dam and at various places along the right abutment slope. From these exposures and from a familiarity with the Franciscan formation it seemed most desirable to explore the foundation by means of surface trenching instead of drilling.

A bulldozer trench was carried down the left abutment along the upper portion of the axis that was augmented by hand trenching and pits along the bottom steeper portion of the abutment. Several other small bulldozer trenches were also dug around the brow of the axial ridge to determine the depth of stripping and the character of the overburden for its possible use as borrow material for the fill.

On the right abutment a shallow hand trench was carried down the axis from the crest of the ridge where the serpentine bedrock appeared at the ground surface. Here the residual soil was only a couple of feet thick and the rock was found to be fairly compact and of suitable character as foundation for the dam. Half way down this abutment the terrace overburden became quite thick and except for a 25 foot pit no attempt was made to follow the bottom of this bench. Further trenching was carried on along this axis just above the road.

The channel section was explored by several pits and trenches extending outward along the axis from the base of each abutment. The bedrock appears to be quite flat and no attempt was made to explore beneath the 100 foot wide stream channel

The spillway showed bedrock outcropping along both sides of its channel opposite the end of the dam and so a 675 foot long bulldozer trench was dug along its axis to determine the probable depth of overburden above the bedrock which proved to be somewhat over ten feet in depth. A 225 foot long bulldozer trench was also dug along the circular entry section to the spillway . Here the serpentine bedrock was outcropping at the surface but was weathered rather deeply. However the 8 foot deep trench showed that the serpentine rock was gradually becomming tighter with depth and amply suitable to support the spillway structure.

On each abutment a terrace bench was encountered about 50 feet above the stream channel neither of which was explored to its bottom but the uphill and the downhill bedrock exposures showed the approximate position of these terraces. The terraces may in part be composed of residual surface material that has slumped down the slopes above. The left abutment terrace shows considerable terrace gravel but the right abutment terrace is made up principally of clayey material that may be underlain by gravel.

The conditions exposed by the exploratory trench along the axis of the dam site is shown upon the attached geologic section. Since this work was done the temporary axis along which the trench was located has been abandoned and a new axis for the dam has been selected which is about 100 feet farther downstream at the right end of the dam and about 250 feet farther downstream at the left end. However, the original exploratory trench is representative of the condition along the newly selected axis.

LOCAL GEOLOGY

The areal geology at the dam site is shown upon the attached contour map. The Upper Coyote Gorge in which the Anderson Dam Site is located traverses rocks that belong to the Franciscan formation. The metamorphosed serpentine rocks occupy the upstream 2/3 of the gorge while the lower 1/3 of it is comprised of thinbedded sandstones and clay shales. The contact between these rocks crosses the channel about 450 feet upstream from the final axis of the dam site and runs diagonally through the upper portion of the right abutment intersecting the axis at about 150 feet above the streambed.

A dam site was once considered across the upper end of the gorge where the entire structure would rest upon the serpentine. Here the topographic conditions seem favorable for a dam but the geologic conditions are very poor . At the site selected most of the dam will be resting upon tight clay shales and sandstones which are adequately suited as foundation for an earth structure. The finally selected axis for the dam has been moved downstream more than is desirable from a topographic standpoint but the geologic conditions warrant it so that the inlet structure will not be landed on the unsound serpentine. When the reservoir is filled the serpentine will probably be subjected to further landsliding so that the proper location of the inlet tower and entry structure should be given serious consideration. The material might not only soften and swell but lateral slides could easily cause a dislocation of the foundation and even the tower itself.

The Franciscan formation was laid down about 150 million years ago and is comprised of the oldest rocks in this region. During this long period the formation has been subjected to regional tectonic movements and to long periods of cementation, crushing and metamorphism. The resulting sediments in the vicinity of the dam site are comprised of a predominance of clay shales that are interstratified with thin-bedded sandstones. The original hard igneous rocks that were intrusive into the formation contemporaneously with its deposition are now largely altered to various phases of hard and soft serpentine and also to a hard type known as silica-carbonate rock.

The metamorphism and alteration of the original basic igneous rocks has not only resulted in the various phases of the serpentine but it has also caused contact metamorphism whereby there has been alteration of the rocks that are now in contact with the serpentine. This fusion and alteration may be effective a hundred feet away from the contact. The shales generally become softened and schistose from this action while the massive sandstone often remains massive and altered retaining little semplance to its original composition and structure. On the right abutment there are numerous masses of rock of the latter type.

STRUCTURAL CONDITIONS

Due to the deep surface weathering and to the lack of bedding in the sandstone there are relatively few measurements available at present that show the attitude of the sedimentary beds over the entire site. The regional faulting and the tilting of the beds together with surface creep and deep surface weathering render the reliability of some of the structural measurements questionable.

Faulting is the chief structural feature of the region. The active Haywards Fault zone that runs along Coyote Creek through the Coyote Dam is probably comprised of two major faults, but as can be seen on the Vicinity Map this fault system branches into four distinct faults midway between the Coyote Dam and the confluence between Coyote Creek and Las Animas Creek. From here on in a northwesterly direction these branches become individual faults. All four branches pass to the east of the Anderson Dam Site so that the effect of earthquakes along any of these branches would not cause a dislocation or offset in the structure but would merely subject the proposed dam to earth vibrations.

A secodd structural feature is indicated on the Vicinity Map by a fine dotted line. The aerial photographs suggest a possible fault line connecting the small lake situated on the south side of the canyon with a straight lineal feature on the opposite side. This line is parallel to the Haywards Fault and is suggestive of some minor dislocation that might be associated with it. From a study in the field this line does not have much signicance for it seems to follow along a soft belt of serpentine close to the sedimentary contact on the left side of the canyon and continuing along an eroded depression for a short distance along the hills on the right side of the canyon. The line crosses the channel at the upstream toe of the proposed dam and continues through the serpentine just upstream from the entrance to the spillway.

LEFT ABUTMENT

The revised location of the dam as shown on the attached contour map of the site has the left end of the dam resting on the brow of the ridge. This has pulled the upstream toe of the dam downstream considerably from its original position in the channel section and has allowed a better foundation condition for the base of the intake structure. It is generally undesirable to have an embankment lap over the downstream side of a ridge but in this case it is probably justified because of the geologic conditions upstream.

The brow of the hill underlying the ~~the~~ left abutment, as shown by the axial trench, by the exposures along the base of the abutment and by the several trenches that have been dug around the hill, is composed of clay shale and some thinbedded sandstone. The configuration of the slope is also indicative that the overburden on the brow of the hill beneath the dam might not be so deep as found along the axial trench.

Exposures of shale and sandstone occur all along the old road cut upstream from the concrete bridge and at one place downstream from the bridge. Near the upstream toe of the dam the old road is crossed by a fence line which here marks the contact between the Franciscan sediments and the serpentine. Along the old road location beyond this fence there is first a 65 foot width of hard serpentine rock beyond which the formation is all soft weathered serpentine as far as the upper end of the gorge. In this soft serpentine area there are some extensive slides but they do not encroach upon the Franciscan sediments.

RIGHT ABUTMENT

As can be seen from the contour map the right end of the dam terminates at the crest of a serpentine knoll. The contact between the serpentine and the sediments runs diagonally across the abutment. Along this contact there are several hard outcrops of contact rock which was probably sandstone originally. The contact is well exposed at the base of the abutment below the road about 200 feet upstream from the axial trench. The serpentine encountered in the trench is fairly hard and suitable foundation for the dam and cutoff trench.

can be carried away from the dam and discharged back into Coyote Creek safely below the downstream toe of the structure. This natural depression is bounded on its right side by a continuous mass of serpentine. Its entry section and the first 800 feet of its alignment are bounded by serpentine also and the character of this rock is fairly hard. The first 800 feet on the left side of the spillway are a part of the ridge against which the right end of the dam terminates. This ridge ends at the cross ravine where sandstone underlies the spillway section and from here on down the channel discharge section the foundation rock under the alignment as well as on the left side of it is composed of Franciscan sediments in the form of sandstone, chert and shale.

It is suggested that the first 800 feet of the spillway channel be entirely lined with concrete and that the remaining portion of the discharge channel be cut down to grade so that the spillway waters can discharge freely over the bedrock formation and find their own way down the slopes of the canyon to the stream channel.

OUTLET

A natural grade line already exists where the old abandoned road once ran along the base of the left side of the canyon. This old grade is about 30 feet above streambed. Outcrops of shale and sandstone are in evidence all along this old road cut so that little difficulty should be had in preparing a foundation along it for a cut and cover conduit from the reservoir.

This old road grade is now obliterated by serpentine slides upstream from the formational contact near the old fence line, but immediately upstream from the fence there is a hard rib of serpentine rock following along the contact that might prove satisfactory as the foundation for the inlet tower and structure. This serpentine is much like the igneous rock from which the serpentine was derived and in the past it was quarried for grading the roads. This mass of rock is about 65 feet wide but while it appears massive it should be explored to be sure that it is not underlain by soft serpentine material.

AVAILABILITY OF CONSTRUCTION MATERIAL

The proposed Anderson Dam will require approximately 2 1/2 million cubic yards of embankment material. A reconnaissance of the area shows that there is ample material available for such use, but the closest borrow areas show a predominance of impervious clays. It would be desirable to obtain a large proportion of pervious fill, if possible to stabilize the slopes of the dam since it is proposed to place the impervious material in the central portion of the structure.

There is a large volume of residual clay along the flanks of the left abutment ridge facing the Santa Clara Valley which extends along the foothills for a long distance. This is the most accessible material.

Sandstone outcrops are found along the abutment and in the ravine that runs down the slope toward the concrete bridge as well as at the spring where the spillway channel crosses this ravine. Sandstone of a very hard quality as well as considerable shale and bedded sandstone were encountered in the axial trench above the county road. On this abutment, as was found on the opposite side of the dam site, there is a terrace bench running along the slope of the hill about half way up the abutment above the road. The left abutment bench showed considerable terrace gravel but on the right abutment the material on this terrace bench is chiefly clay and residual rock fragments. Where the trench runs down the slope there is a slight bulge with serpentine rocks at the surface, but the trench excavation showed that surface rocky material was only serpentine float and that the material had evidently slumped down from the higher outcrops of rock and lodged in the terrace bench. A pit was sunk down into this slide material for a depth of 25 feet but at this depth neither bedrock nor terrace gravel had been encountered. This terrace bench is not believed to be so extensive along the hill side as at the trench location, because of the local slide condition, while downstream along this same position there are rock outcrops and the hill slope is quite uniform and steep.

CHANNEL SECTION

The channel section along the axis of the dam site is about 200 feet wide and bedrock was encountered at very shallow depths along the trench line for 50 feet out from the base of each abutment. The unexplored 100 foot wide section beneath the present stream channel is not believed to be over 25 feet deep at its maximum depth. Of the entire 1650 ~~feet~~ foot length of the channel section of the dam only the upstream 150 feet shows evidence of being underlain by serpentine, the rest being comprised of shale and sandstone. The channel section is undoubtedly filled with hard waterworn boulders and gravel but the low dam that forms the pool for the resort at the bridge and backs water up along the dam site to a depth of about three feet has caused the surface gravels to become covered with sand and silt.

CUT-OFF

The proposed earth dam will have its impervious section along the central portion of it and so the cut-off trench will be excavated somewhere beneath this area undoubtedly near the upstream edge of it. The depth of the cut-off will depend largely upon the character of the bedrock material encountered. The formation encountered along most of the cut-off will be shale and sandstone except near the upper portion of the right abutment where the serpentine rock has been exposed. This trench can all be excavated with a bulldozer and ripper beneath the overburden and even into the bedrock. The back fill material for the cut-off trench should be impervious clay that is properly compacted.

SPILLWAY

The spillway site is a natural depression just beyond the right end of the dam that leads across several low ridges where the water

The heavy stripping from the dam site and from the spillway channel can also be reworked for use in the impervious portion of the fill. Additional impervious material, if needed, can be obtained from the reservoir basin along Coyote Creek just above its junction with Las Animas Creek.

Pervious material is rather scarce in close proximity to the site. The channel section downstream from the dam site would afford a limited quantity of gravel but most of this area is in orchard and the existing flood plain of the creek is believed to be rather shallow below the gorge and to contain a large percentage of boulders and cobbles which would render it undesirable for compaction.

There is quite a sizable hill of red chert which is part of the Franciscan formation located about 1800 feet downstream from the axis of the dam on the right side of Coyote Creek that would afford a considerable yardage of excellent pervious fill.

The most promising borrow area for pervious material is believed to be the Pliocene deposition of gravels, sands and clays that are locally known as the Packwood Gravels. They occupy an extensive area along the east side of Las Animas Creek northerly from its junction with Coyote Creek. The haul from this area would be close to one mile which is not prohibitive if material can not be found closer at hand.

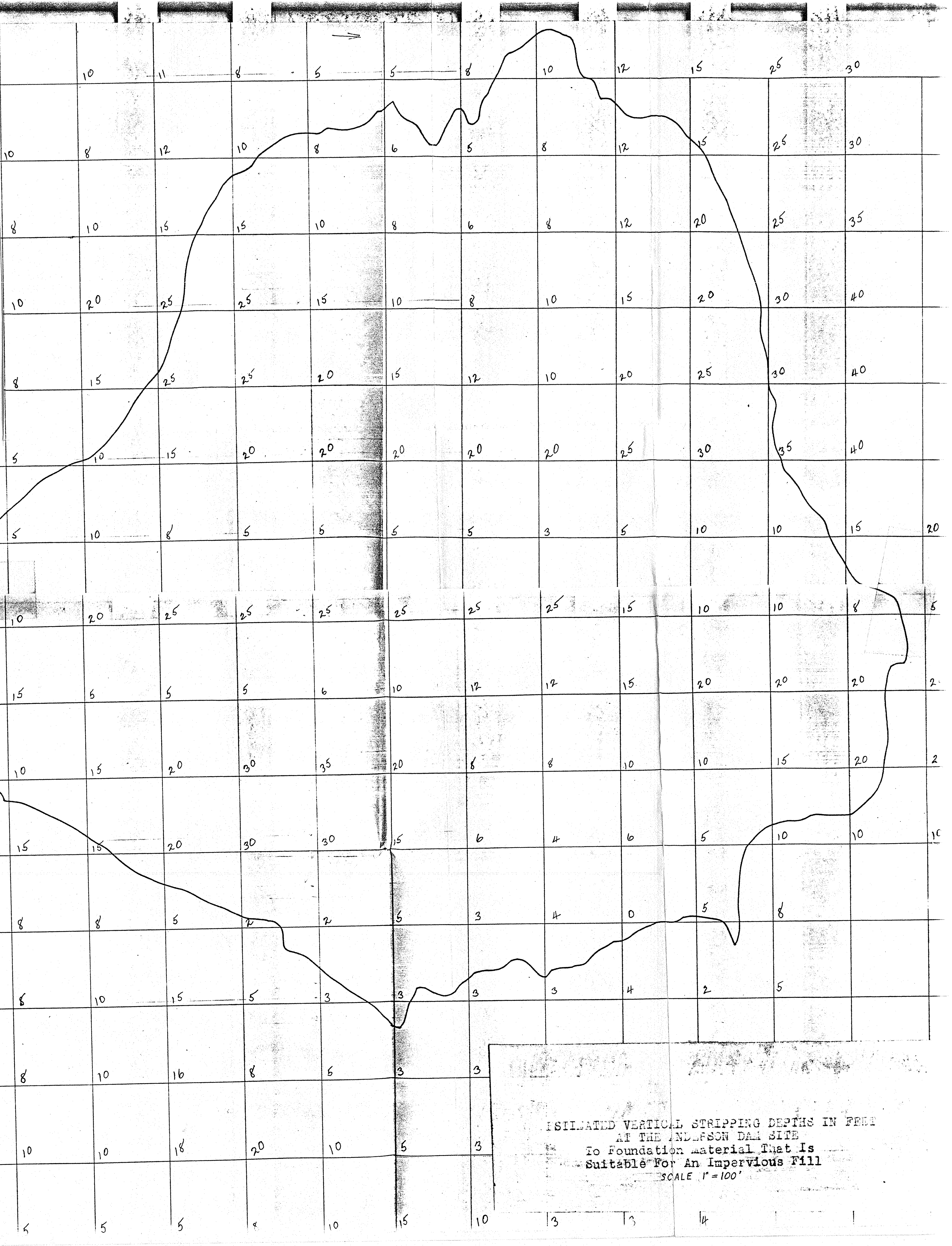
Riprap material for facing the dam is obtainable from two nearby sources. A flow of hard basaltic lava about 20 feet in thickness occupies a very accessible location only a few hundred feet upstream from the junction of Las Animas Creek and Coyote Creek along the east side of Las Animas Creek. A second source of riprap is a thick rib of hard silica-carbonate rock that is part of the serpentine formation. It has a nearly vertical attitude and extends up the side of the canyon as a bold outcrop and is located only about 1200 feet upstream from the axis of the dam site along the present county road.

Concrete aggregate will be required at the dam only in limited quantities. It would undoubtedly be more economical, to obtain this type of material from one of the nearby sources in the valley than attempt to salvage sand and gravel from the channel of Coyote Creek.

CONCLUSIONS

(1) The Anderson Dam Site is topographically and geologically a good location to construct a high embankment type of dam.

(2) The proposed height of 240 feet above streambed affords an excellent natural location for a spillway beyond the right end of the dam where the overflow would be safely removed from the structure and discharged back into its natural channel far removed from the downstream toe of the dam.



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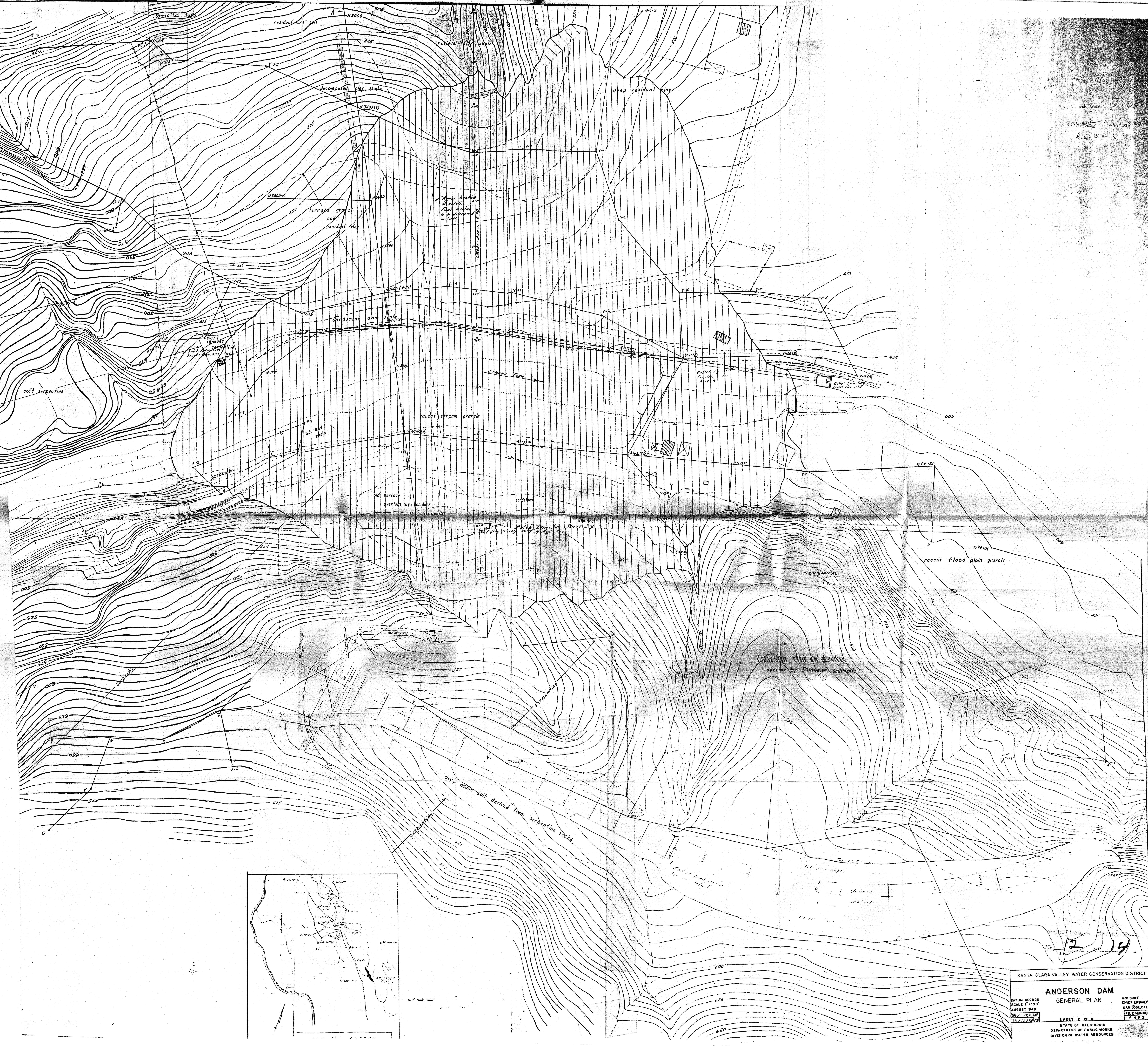
ESTIMATED VERTICAL STRIPPING DEPTHS IN FEET
AT THE ANDERSON DAM SITE
To Foundation Material That Is
Suitable For An Impervious Fill
SCALE 1" = 100'



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SANTA CLARA VALLEY WATER CONSERVATION DISTRICT

ANDERSON DAM

GENERAL PLAN

DATUM USC&GS
SCALE 1" = 80'
AUGUST 1949
DR … CK …
TR … AP …

G.W. HUNT
CHIEF ENGINEE
SAN JOSE, CAL

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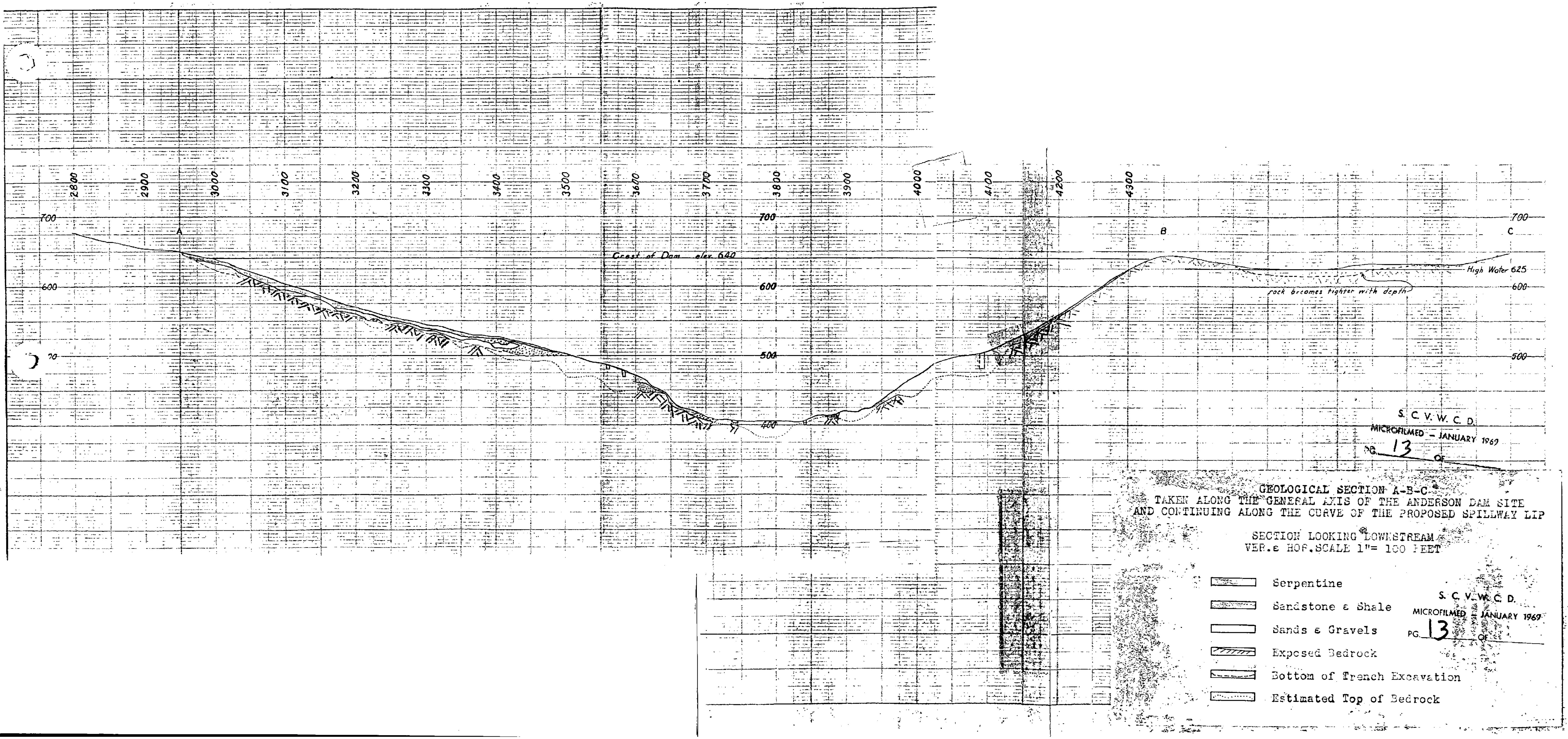
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES



GEOLOGICAL SECTION A-B-C

TAKEN ALONG THE GENERAL AXIS OF THE ANDERSON DAM SITE
AND CONTINUING ALONG THE CURVE OF THE PROPOSED SPILLWAY LIP

SECTION LOOKING DOWNSTREAM
VER.& HOR.SCALE 1"= 100 FEET

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